AIRPHOTO INTERPRETATION OF ENGINEERING SOILS OF TIPPECANOE COUNTY, INDIANA

JULY, 1963

NO. 19

by

P.T. YEH

Joint Highway Research Project

PURDUE UNIVERSITY
LAFAYETTE INDIANA

Digitized by the Internet Archive
in 2011 with funding from
LYRASIS members and Sloan Foundation; Indiana Department of Transportation

http://www.archive.org/details/airphotointerpre6319yehp

Final Report

AIRPHOTO INTERPRETATION OF ENGINEERING SOILS OF TIPPECANOE COUNTY, INDIANA

by

P. T. Yeh
Research Engineer

Joint Highway Research Project

Project: C-36-51B

File: 1-5-2-36

Purdue University
Lafayette, Indiana

ACKNOWLEDGMENTS

The author wishes to acknowledge the assistance given by all those persons who have helped in the preparation of this report. Special acknowledgments are due the members of the Advisory Board, Joint Highway Research Project, for their active interest in furthering the study; to Professor H. L. Michael, Associate Director, Joint Highway Research Project, for review of the report; Professor R. D. Miles, in-charge of Airphoto Interpretation Laboratory, for his review and suggestions; Professor E. J. Yoder, in-charge of the Soil Testing Laboratory, for his efforts in supervising the soil testing; Mr. T. C. Bass, State Soil Scientist, Soil Conservation Service, for his efforts in identifying the soil horizons of the soil profile.

All airphotos used in connection with the preparation of this report automatically carried the following credit lines: "Photographed for Commodity Stabilization Service, Performance and Aerial Photography Division, "United States Department of Agriculture".

Airphoto Interpretation of Engineering Soils of Tippecanoe County, Indiana

by

P. T. Yeh

INTRODUCTION

The Engineering Soils Map of Tippecanoe County, Indiana which accompanies this report, was compiled from 7-inch x 9-inch aerial photographs having an approximate scale of 1:20,000. Most of the aerial photographs were taken in the Fall of 1938 and the Spring of 1939 in connection with the United States Department of Agriculture program and were purchased from that agency.

Aerial photographic interpretation of the land forms and engineering scales of this county was accomplished in accordance with accepted principles of observation and inference (1)*. Field trips were made to the area for the purposes of resolving ambiguous details, correlating aerial photographic patterns with soil textures, and to secure soil samples for laboratory testing purposes. Standard mapping symbols developed by the staff of the Airphoto Interpretation Laboratory, School of Civil Engineering, Purdue University, were employed to delineate land forms and soil texture. The text of this report largely represents an effort to overcome the limitation imposed by adherence to a standard symbolism.

An approach towards better utilization of engineering soil maps of Indiana has been attempted with the inclusion of soil profile and laboratory engineering soil classifications for the principle soils represented within this county.

Certain soils of obvious inferior engineering qualities, were not sampled but were indicated on the attached map. The soil profile was compiled from the agriculture literature. These soils include principally organice materials such as muck and peat which are of only limited extent in Tippecanoe County.

Liberal reference was made to the "Soil Survey of Tippecanoe County, 1959" (2) published for the United States Department of Agriculture and "The Formation, Distribution and Engineering Characteristics of Soils" (3) published by the Engineering Experiment Station of Purdue University. In many instances the agricultural soils survey did provide a convenient endorsement of the photo interpretater's judgment.

---

*Figures in parentheses refer to references appearing in the bibliography.

DESCRIPTION OF AREA

General

Tippecanoe County is located in the west central part of Indiana (Fig. 1). It is rectangular in shape and has an area of 501 square miles (2). Lafayette is the county seat and is located near the center of the county. It is the only large town within the county. A population of 89,122 inhabitants resided within the county, with 42,330 reported for Lafayette, and 12,680 for West Lafayette in the census 1960 (4).

According to the 1959 census of Agriculture, there were 280,727 acres of farm land (about 87.6% of the county area) in Tippecanoe County (5). Wooded areas are generally confined along streams and rivers as shown in Fig. 2.

Drainage Features

Tippecanoe County lies wholly within the drainage basin of the Wabash River, which crosses the county from the northeastern corner to near the center of the western boundary (Fig. 3). Wildcat Creek and Big Wea Creek are the major tributaries from the south and Tippecanoe River, Burnetts Creek and Indian Creek are the larger tributaries from the north.

The principal surface drainage systems are well developed throughout the county. There are, however, many ditches on the upland to improve drainage condition for the nearly level regions. The Wabash River Valley north of Lafayette flows within the ancient preglacial Teays River Valley (6). It is an entrenched valley that was filled and re-excavated; therefore, the Wabash River has huge terraces and comparatively narrow flood plains within this region.

Climate

The climate of Tippecanoe County is continental, humid, and temperate. The warm humid summers and moderately cold winters are characterized by frequent sudden changes of temperature. The wide variations occurring within a season can be seen from the absolute minimum and maximum temperature listed on Table I (7). The average annual precipitation is 38.26 inches. Nearly 60 percent of this falls from April through September.

Physiography

Tippecanoe County lies wholly within the Tipton Till Plains physiographic region of the State (8, p. 66). With respect to its physiographic situation in the United States, the county is a part of the Till Plains Section of the Central Lowland Province (8, p. 69).

FIG. 1 LOCATION MAP OF TIPPECANOE COUNTY

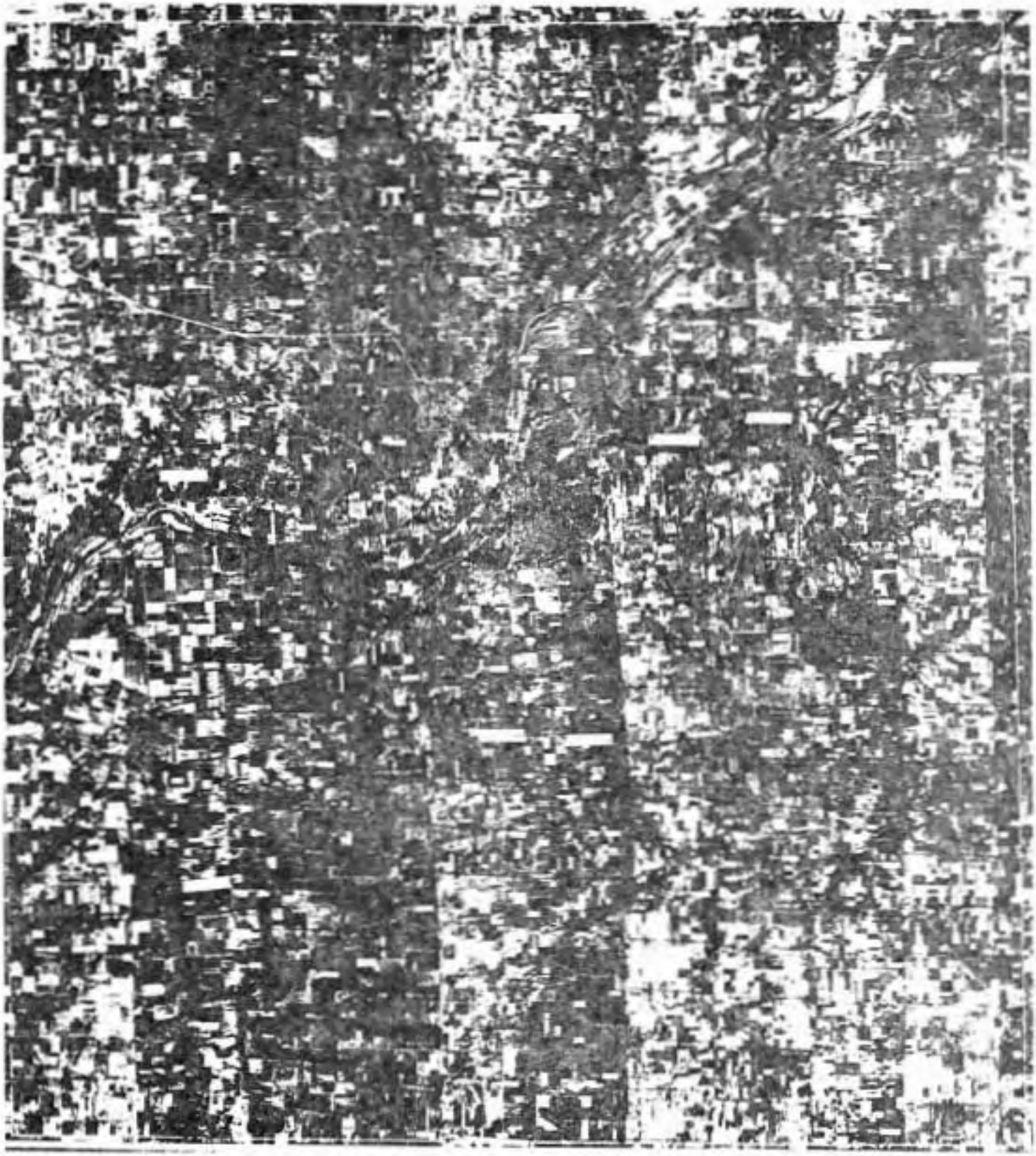
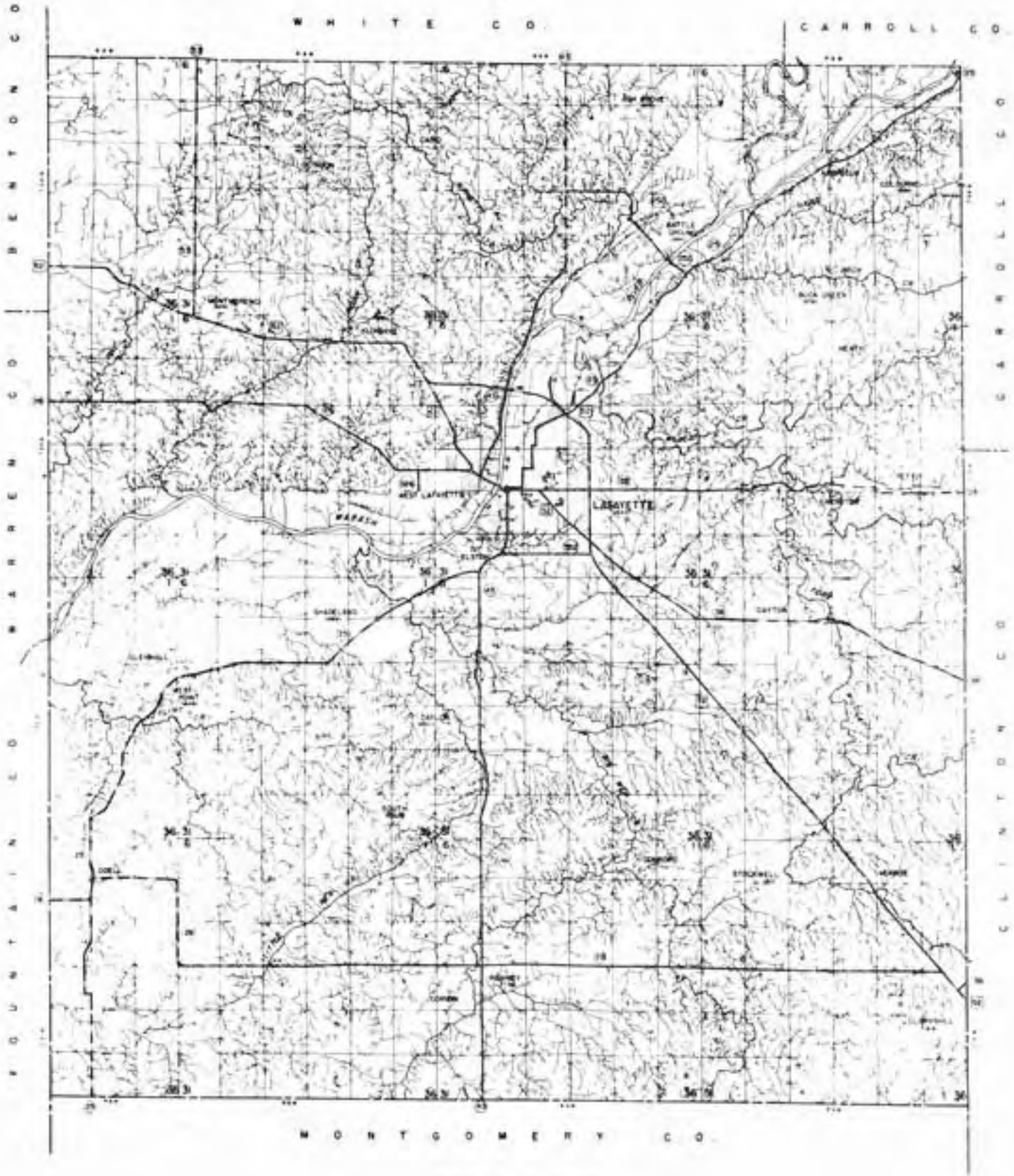


FIG. 2 AIRPHOTO MOSAIC OF TIPPECANOE COUNTY

FROM 1958 INDEX MAP



DRAINAGE MAP

TIPPECANOE COUNTY

INDIANA

PREPARED FROM

1939 AAA AERIAL PHOTOGRAPHS

BY

STATE HIGHWAY COMMISSION OF INDIANA

AT

PURDUE UNIVERSITY

1948

FIG. 3

Table I

NORMAL MONTHLY TEMPERATURE AND PRECIPITATION AT

WEST LAFAYETTE, TIPPECANOE COUNTY, INDIANA

(Elevation 706 Feet)[1]

	Temperature[2]			Precipitation[3]		
Month	Average °F	Absolute Maximum °F	Absolute Minimum °F	Average Inches	Driest Year (1914) inches	Wettest Year (1927) inches
January	26.5	70	-33	2.56	2.30	1.57
February	28.7	70	-26	2.33	2.17	2.10
March	39.2	87	-12	3.11	1.57	3.88
April	50.9	90	10	3.49	2.82	6.28
May	61.9	97	27	4.19	2.30	9.21
June	71.3	104	33	3.97	1.60	4.62
July	75.6	111	42	3.75	0.28	4.71
August	73.4	103	39	3.45	4.87	2.49
September	66.8	101	24	3.32	1.90	5.87
October	54.6	92	16	2.68	1.60	4.05
November	41.0	82	- 5	2.84	1.09	6.56
December	30.4	69	-20	2.57	2.54	3.57
Year	51.7			38.26	25.05	54.91

1. The elevation of the station has been changed from 601 feet (July 1952) to 620 feet (November 1953) to the present elevation of 706 feet.

2. The average temperature is based on 72-year records through 1952. Absolute temperatures include 1962 records.

3. Average precipitation is based on a 73-year record through 1952. This table is compiled from the "Climatological Data of Indiana".

Topography

The surface of Tippecanoe County is a gently undulating plain sloping toward the entrenched Wabash River Valley from both the northwestern and the southeastern corners of the county as shown in Fig. 4. Remnants of poorly defined morainic ridges of the Bloomington morainic system are scattered throughout the county (see Fig. 5). The morainic areas generally exhibit an undulating to softly rolling surface especially on those remnants located in the northwestern part of the county. Rolling to hilly morainic topography is concentrated in the southern part of the county. Clusters of sharp knolls, kames and eskers 15 to 40 feet in height are found between the town of West Point and Taylor and on the morainic region in the vicinity of Romney and Corwin (see attached map). Shawnee Mound and Cemetery Hill, located in the southwestern corner of the county and rising as much as 75 feet above the surrounding areas, are the prominent features of the county (9). In the ground moraine or the till plain area the most conspicious topographic features are the low knolls and ridges that rise a few feet above the nearly level plain. Some are conical kames and some are long winding eskers. Most of them are only 10 to 20 feet high. Some as high as 60 feet are located near the town of Dayton. Depressions and swales also exist on the ground moraine. These kettle holes were formerly marshy, but most of them are now drained.

The average elevation above sea level is about 680 feet in Tippecanoe County. The highest point, with an elevation of 840 feet is situated near the town of Clarkshill in the southeastern corner of the county. The lowest elevation of 495 feet is located on the western border where the Wabash River leaves the county. The maximum relief therefore, is 345 feet.

The Wabash River Valley is the most striking physiographic feature of the county. The most rugged topography of the county is along the valley walls, especially along the western bank north of West Lafayette. The maximum local relief, about 210 feet, is obtained along the valley wall north of West Lafayette. There are two main levels of stream terraces along the Wabash River. The high terrace is above 600 feet in elevation while the lower one is about 500 feet in elevation. Both of the terraces are flat-topped and separated from the adjacent flood plain by short, steep slopes. Some sand dune formation are recognized on the flat-topped stream terraces in the Wabash Valley. They are mostly low dunes of irregular shape about 10 to 20 feet higher than the surrounding terrace.

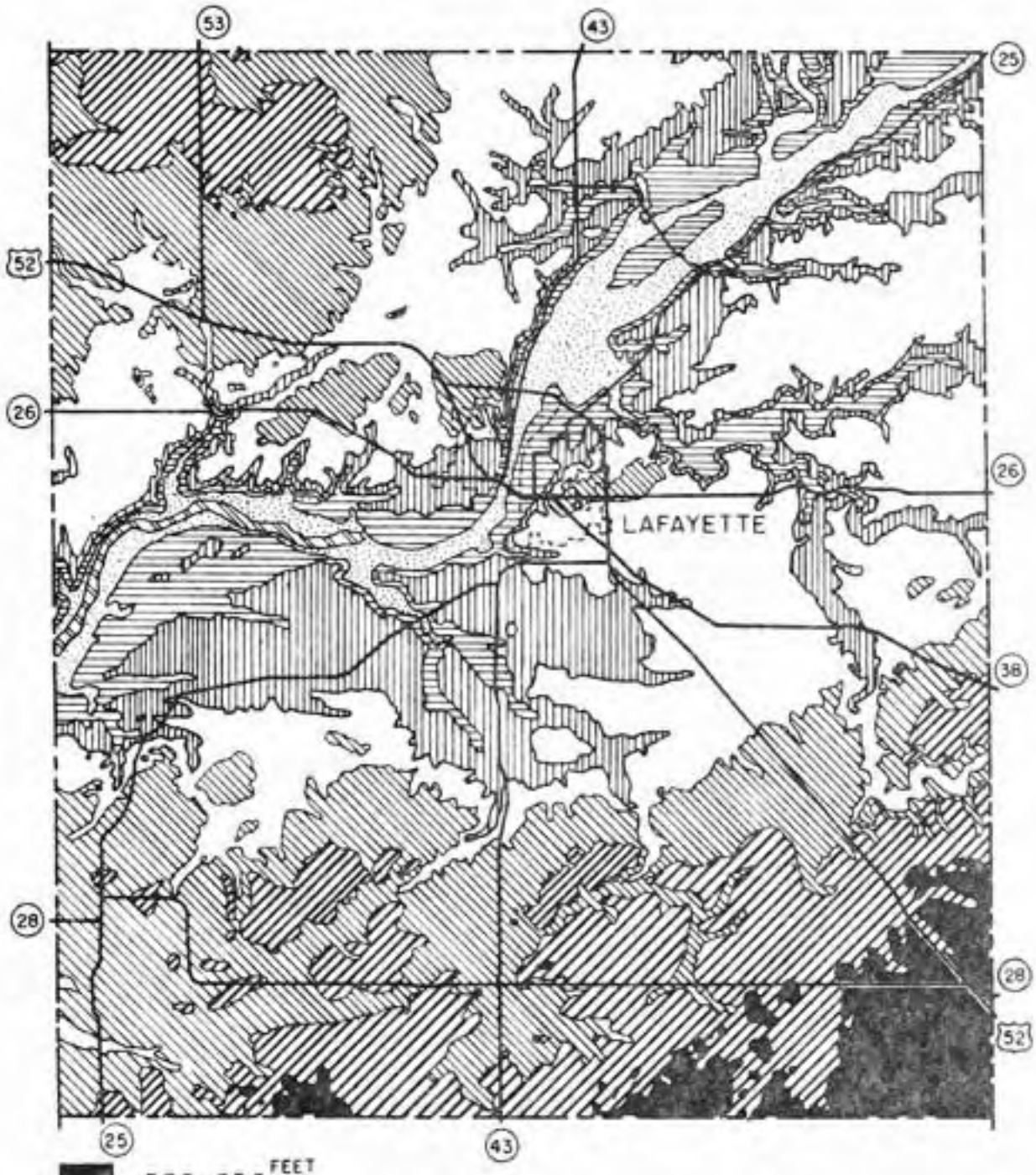


FIG. 4 TOPOGRAPHIC MAP OF TIPPECANOE COUNTY, INDIANA.

FIG. 5 GLACIAL MAP OF INDIANA

Dissected and rugged topography is pronounced in the eastern and central part of the county along Wildcat Creek. Steep and highly dissected slopes are found along the valley walls. Both Indian Creek and Wea Creek also create highly dissected features.

Geology

The bedrock formations of Tippecanoe County are composed largely of strata of Devonian and Mississippian periods. A small area of Pennsylvanian sandstone is present in the extreme western part of the county (10). The Devonian rocks are exposed in the northeastern part of the county and the Mississippian strata in the southwestern part. Outcrops of Devonian shale occur along the valley walls of the Wabash River near the town of Americus and near the western border of the county. Other outcrops occur in the valley of Indian Creek near the town of Klondike and in Flint Creek southwest of the town of West Point. The bedrock was deeply trenched before the disposition of the glacial drift which covers all of the county except where it has been removed by stream erosion. The glacial drift attains a thickness of about 435 feet as reported from a well log located within sec. 27, T.21 N., R. 4 W. about 2.5 miles southeast of the town of Romney. An artesian well penetrated over 170 feet of glacial drift at the court house in Lafayette (9, p. 104). The well log was reported as follows:

	Ft.	In.
Clay	3	0
Clay and gravel	9	6
Gravel and pebbles	1	6
Gravel, fine, and sand	13	0
Quicksand	1	0
Gravel, clay, and pebbles	2	6
Clay, dark gray	72	0
Sand and gravel	4	0
Clay and pebbles	1	3
Sand and gravel	7	3
Clay		6
Sand and gravel	3	0
Clay and pebbles	6	6
Gravel, pebbles and boulders	45	0
Total	170.0	

The following geological divisions in Tippecanoe County have been recognized in outcrops and in the record of wells (9):

Quaternary.	Unconsolidated sands, clays, gravels (recent) Unconsolidated sands, clays, gravels (pleistocene)
Pennsylvanian	Sandstone (Mansfield)
Mississippian	Shales, siltstones, sandstones (Borden) Limestone (Rockford)
Devonian.	Shale (New Albany) Limestones (Sellersburg, Jeffersonville) Sandstone (Pendleton)
Silurian.	Limestones

The formations of Tippecanoe County dip in a southwesterly direction. The upper surface of the Trenton (Ordovician System) lies slightly more than 300 feet and about 800 feet below sea level in the northeastern and southwestern part of the county respectively.

LAND FORMS AND ENGINEERING SOIL AREAS

Engineering soils in Tippecanoe County are derived chiefly from glacial drift deposits. However, a great portion of the glacial drift is covered by a thin (18 to 36 inches) mantle of eolian deposits (Loess) on both sides of the Wabash River Valley. Glacial-fluvial and alluvial deposits are found along the major drainage channels. A number of eolian deposits of sand in the form of dunes are recognized on the terraces and the outwash plains. A very limited area of residual soil derived from the exposed sandstone and shale bedrock occurs in the western part of the county. Two bouldary belts of glacial origin were found and indicated on the engineering soils map with appropriate symbol. The soils of Tippecanoe County are further complicated by the influence of vegetation. A dark colored, organic topsoil is found on the prairie plain in the western part of the county in contrast to the light colored soils of the forested or formerly forested areas in the remainder of the county.

GLACIAL DEPOSITED MATERIALS

About three quarters of the area within Tippecanoe County is covered by glacial deposits. The characteristics of the glacial drift varies considerably with land form of deposition. The various deposits are discussed as follows:

1. Ridge Moraines

Ridge moraine deposits occupy about one quarter of the area of the county. Most of the moraines are in the form of low remnants especially those located in the northwestern quarter of the county. They exhibit a gently undulating typography and are only slightly higher than the surrounding ground moraine.

Increasingly stronger morainic topography is found toward the southern part of the county. However, rolling and hilly topography are rare except in the "Highgap Ridge" which lies between West Point and Taylor and in a small morainic area south of Romney. The ridge moraines, for purposes of discussion, are subdivided into three different textural groups namely: (a) the coarse-textured ridge moraine; (b) the medium-textured ridge moraine; and (c) the loess covered, medium-textured, ridge moraine.

(a) Coarse-Textured Ridge Moraines

The coarse-textured ridge moraine exhibits the strongest topographic expression. The largest coarse-textured ridge moraine occurs between West Point and Taylor. Many well defined eskers and kames are found within this area and are mapped separately. Another coarse-textured ridge moraine is located about two miles south of Romney. It also exhibits an esker on the northern border and many kames occur within the moraine. Two smaller areas are recognized with one located south of Dayton and the other northeast of Romney.

The soils of this ridge moraine group, in general, are sandy to gravelly in texture. The surface soils are chiefly loam but clay loam or silty clay loam may appear in places. The B-horizon contains a little more clay than the layer above and may be classified as sandy clay or gravelly clay depending on the amount and size of coarse material. The parent material is stratified gravel and sand. Locally, the parent material in low knolls may be a clay loam or loam.

In the shallow depressions or basins, heavy textured soils are predominant (2,3). The surface soils, which vary from silty clay to clay are very dark in color and contain considerable amounts of organic matter. The B-horizon contains more clay than the surface layer. The parent material varies from loam to clay. In the deep depressions, especially those surrounded by high knolls, a colluvial soil is usually present. The materials are light grayish brown friable silt loam or intermixed layers of clay, silt and sand. The thickness of the colluvial deposit varies from 10 to 40 inches. The underlying materials are dark colored, heavy-textured soils.

(b) Medium-Textured Ridge Moraines

There are three medium-textured ridge moraines in Tippecanoe County. One is situated near the northwestern corner of the county, the others are located in the vicinity of Octagon and in the southwestern corner of the county. Gently

undulating topography is found on the moraine in the northwestern part of the county. A more rolling type of morainic landscape is observed on the moraines in the southwestern part of the county.

This morainic area, except for a narrow strip just south of the outwash plain on the southwestern ridge moraine, was under prairie vegetation. Therefore, the surface soil, in general, is a dark colored, organic silty clay loam. Test samples taken at sites No. 2 and No. 5 illustrate this point. A clay B-horizon and a clay loam parent material are common in these morainic deposits. Local variation, however, are expected. The sample taken at site No. 15 is likely to be influenced by the nearby gravelly deposits. It is very sandy in texture and has a clay topsoil and subsurface soil and a gravelly sandy loam parent material.

The soil profile in the depressions is characterized by an organic silty clay to clay topsoil and a silty clay to clay subsoil. The parent material varies from loam to clay.

(c) Loess Covered, Medium-Textured, Ridge Moraines

The bulk of the ridge morainic mass in Tippecanoe County is placed under this category. The main body of this moraine lies in the southern part of the county. This massive ridge moraine is interspersed with nearly level ground moraines and depressions. There are a few isolated remnants of this type of moraine in the northwestern quarter of the county.

The thickness of the loess cover varies from about 18 to 36 inches on these moraines. Undulating topography is predominant; however, rolling to hilly landscape may occur, locally, especially on the moraine area that lies southwest of Montmorenci.

The soils of the ridge moraine that is located in the southern half of the county west of Concord have been developed under prairie vegetations. The darker surface soil and lack of trees can be recognized easily from the airphotos of this area. The A-horizon of the soil profile in the prairie land is much darker in color and contains considerably larger amounts of organic matter than that of the timberland soil. Samples taken at sites 7, 8, 9, and 17 show the variation of the soil profiles of this group. The A-horizon is generally classified as a silty clay loam, a soil containing high percentage of silt. The B-horizon is clayey. The parent material varies from a loam to a clay loam with increasing amount of sands and gravels with depth.

In the depressions or basins a higher organic topsoil of greater depth is recognized in the profile. The B-horizon contains a high percentage of clay while the parent material is a clay loam.

2. Ground Moraines

Extensive areas of ground moraine exist in Tippecanoe County. The most extensive deposits are located in the northern half of the county. Many smaller ground moraine located in the southern part of the county. The topography of the ground moraine is nearly level except along the vicinity of drainage systems where dissected and undulating topography occurs. The ground moraines in the county can be subdivided into two groups: (a) the medium-textured ground moraine and (b) the loess covered, medium-textured, ground moraine.

(a) Medium-Textured Ground Moraines

The medium-textured ground moraine deposits are mostly confined to the northwestern quarter of the county. The ground moraine areas located in the northwestern corner are separated by a very weak ridge moraine. These areas developed under prairie conditions. Another ground moraine, stretching along the northwestern bank of the Wabash River from West Lafayette to the northern border of Tippecanoe County, exhibits a very gently undulating topography except in the vicinity of drainage channels. East of the Wabash River between Lafayette and Buck Creek there lies another, somewhat level ground moraine. Another one occurs east of Americus. All these latter ground moraines developed under timber cover.

The soil profiles developed on the ground moraines in the northwestern corner of the county exhibit an A-horizon that is much darker in color and contains considerably more organic matter than the soil profiles of the timber-covered soil. The soil profile contains samples obtained at sites 1 and 4 illustrate this fact. The top soil in this area is an organic clay. The B-horizon is a clay. Coarse particles are found in the parent material and it is generally classified as a clay loam. Site 4 is situated on a shallow depression. It has a high clay content B-horizon and a gravelly sandy loam parent soil.

The soil profiles at sites 19, 20 and 23 represent engineering soil conditions on the ground moraines developed under timber cover. The topsoil varies from a silty clay to clay loam. The B-horizon is similar to the other ground moraine as is the parent material.

(b) Loess Covered, Medium-Textured, Ground Moraines

The majority of ground moraines in Tippecanoe County belong to this group. The main body lies within the northwestern quarter of the county. The continuity of this featureless mass is broken by ridge moraine remnants and

river channels. Another loess covered ground moraine is located in the northeastern part of the county. In the southern half of the county the ground moraine is separated into many small segments by a number of ridge moraines.

The loess cover on the medium-textured ground moraine varies in depth from about 18 to 36 inches. The ground moraines that are located north of Montmorenci, west of Cairo, some small sections south of "Highgap Ridge" between West Point and Taylor, and those west of Stockwell are subject to the influence of prairie vegetation. A dotted line is used on the soils map to outline these areas.

The soil profiles of loess covered ground moraines are characterized by an organic silty clay topsoil, a clay subsoil and generally a clay loam parent material. Test sites 3, 6, 16, and 32 are representative of the region.

The soil profiles developed on the loess covered ground moraines under timber vegetation are characterized by a silty clay loam A-horizon a silty clay B-horizon and a clay loam C-horizon. The high silt content of the loess in the A-horizon is recorded for site 11. The amount of silt decreases very rapidly with the amount of coarse particles increases correspondingly with depth. In the slightly lower topographic position, a higher clay content B-horizon is encountered as illustrated in the soil profile at test site 24. The organic A-horizon in site No. 18 may be considered as a local variation.

3. Moraines on Bedrock

Several small areas in Tippecanoe County where bedrock is exposed near the ground surface, are considered as regions of moraine on bedrock. The largest area is located along the south bank of the Wabash River near Americus. Another occurs on the southern side of the Wabash River near the western border of the county. Small isolated areas are found along the Indian Creek west of Klondyke, about two miles northwest of Taylor and along Flint Creek west of West Point.

The drift is a thin veneer, about 18 to 45 inches in depth, overlying shale and sandstone bedrock. The soil profile is characterized by a silt loam to a silty clay loam topsoil underlined by a silty clay to clay subsoil. Rock pebbles and fragments are encountered at a depth of 20 to 45 inches. Sandstone bedrock overlies the shale along the western border of the county. The underlying shale, encountered on the lower slopes of the valley walls of several rivers and creeks, is thinly bedded and very susceptible to weathering.

4. Kames and Eskers

There are a number of kames and eskers in Tippecanoe County. Most of them occur within the southwestern quarter of the county. The most outstanding esker, about two miles in length, is located southwest of South Raub. This esker somewhat parallels little Wea Creek. Another is located about two miles south of Romney. This esker trends east-west. The most concentrated area is the "Highgap Ridge" between West Point and Taylor where fourteen eskers are recognized. The majority of the eskers are narrow ridges and rather low. They average about one mile in length. The eskers are very easily delineated on the aerial photographs.

Kames are also concentrated in the southwestern corner of the county. "Shawnee Mound" in Sec. 30, T.21 N., R. 5 W. rises 75 feet above the surrounding ground. "Cemetery Hill" in Sec. 32, T.21 N., R. 5 W. also rises about the same magnitude. Two kames about 60 feet high occur near Dayton in Sec. 34, T.23 N., R. 3 W. and Sec. 5, T.22 N., R. 3 W. The rest of the kames are relatively low.

The soils developed on eskers and kames vary considerably. Due to the thin loess mantle and the degree of erosion, the A-horizon varies greatly in both texture and in thickness. Sandy loam, loam, clay loam, silt loam and silty clay loam may be found. In areas of severe erosion the surface soil may be entirely gone and the subsoil is exposed. The B-horizon varies from clay loam to clay with varying amounts of sand and gravel for different deposits. The amount of sand and gravel increases very rapidly with depth. Clean stratified sands and gravels are found in the parent material zone. This stratified, coarse material disappears rapidly from the base of the esker or kame and merges with the glacial till in the surrounding areas.

Numerous gravel pits have been developed within the eskers and kames in Tippecanoe County. Most of them are located along the center of the ridge or knoll to avoid heavy overburden.

5. Boulder Belts

Two boulder belts are recognized in Tippecanoe County. The Linden-Darlington boulder belt is located in the southwestern quarter of the county. It trends a northwest-southeast direction passing near Corwin and West Point. The Fowler-Lafayette boulder belt occurs in the northern part of the county. It starts near Monitor and trends toward Lafayette. It reappears near Klondyke and trends westward through the county.

Owing to the intensive farming and clearing activities in the county, a great number of the boulders that strewn over the surface have been removed; therefore, the exact position of the belt cannot be determined. However, from an aerial photographic study correlated with field checks the extent of these belts still can be traced roughly as noted on the engineering soils map. The greatest concentration of boulders on the surface of the ground occurs within the Linden-Darlington belt about two to three miles northwest of Corwin. Most of the boulders are about a foot or two in diameter, but a number of five or six foot diameter were sighted. The surrounding ground mass is a clay rich glacial till in the form of both ground moraine or ridge moraine.

WATER DEPOSITED MATERIALS

Extensive areas of water deposited materials exist in Tippecanoe County. Four different land forms created by the action of water, namely: outwash plain, terrace, lacustrine plain and alluvial plain are discussed as follows:

1. Outwash Plains

The largest outwash plain is located north of a line between Dayton and West Point. Others are located along the Wabash River adjacent to Wildcat Creek and in association with Shawnee Creek in the southwest corner of the county. Due to the difference in texture they are discussed under the following subheadings: gravelly outwash plain, sandy outwash plain, gravelly with fines outwash plain and highly organic topsoil outwash plain.

(a) Gravelly Outwash Plains

The gravelly outwash plains are associated with the Wabash River. A large gravelly outwash plain is located northeast of Battle Ground. Others lie on the south side of the river near Lafayette. A small area is located close to the western border near West Point. These outwash plains all have aerial photographic patterns of outwash plains. Infiltration basins are numerous and occasionally current scars occur. However, due to the influence of the thin loess mantle in this county the demarcation of the infiltration basis is not as sharp as those without the loess cover and also, some surface drainage may have developed in the loess mantle. The surface of the outwash plain is nearly level and, in places, a somewhat inconspicious break is encountered with respect to the adjacent ground moraines.

The A-horizon of the soil profile varies from loam to silty clay loam. The B-horizon subsoils are either silty clay or clay. The amount of sand and gravel increases with depth in the profile and stratified, calcareous sands and gravels are encountered at depths of 40 to 70 inches.

(b) Sandy Outwash Plains

There are two sandy outwash plains in Tippecanoe County. The larger one (about 25 square miles in area) is called the "Wea Plain" and is located south and east of the Wabash River and extends eastward to the vicinity of Shadeland. The other lies in the Southwestern corner along Shawnee Creek. The overall surface varies from undulating to nearly level. The Wea Plain has been subjected to the influence of prairie vegetation, therefore, the topsoil contains a considerable amount of organic matter. The texture of the A-horizon varies from a silt loam to a sandy loam. Sandy clay loam to clay textures are found in the upper B-horizon. The lower B-horizon consists of sand, sandy clay loam or gravelly clay loam. Stratified and slightly calcareous sand is encountered in the C-horizon. Test samples obtained from sites 13 and 35 show the high sand content (72 to 82%). Stratified gravels and sands may be encountered at depths of four to six feet. Due in part, to the overburden and the high percentage of sand for this deposit very few gravel pits have been developed in this region. One rather large gravel pit exists northeast of Shadeland.

(c) Gravelly with Fines Outwash Plains

An outwash plain containing gravel with a mixture of fine material occupying an area about 15 square miles extends between Dayton and Taylor. As observed on aerial photographs, the area exhibits a uniform gray tone with a level surface and a few small infiltration basins (see Fig. 6). A few large depressions occur within the outwash plain. They contain organic materials and are frequently ponded.

The parent material of this outwash plain shows appreciated amount of plasticity. Test samples obtained at sites 28, 30, 33, and 34 illustrate this fact. The A-horizon varies from a silt loam to a silty clay loam and the subsoils are clay at all sites. An increase in the amount of sand and gravel with depth is shown for most sites except site 28 where more silt fraction is observed. The parent materials are sandy gravel with fines and show a plasticity index range of from 5 to 16 percent.

(d) Highly Organic Topsoil Outwash Plains

Areas classified as highly organic topsoil outwash plains are confined mainly to the local basins within gravelly with fines outwash plain region previously mentioned. Some areas, of this development, however, are located in the southwestern corner of the county in association with Shawnee Creek and Little Wea Creek. The depression exhibit a nearly level topography. Very dark photo tones (see Fig. 6) are associated with these features on the aerial photographs.

FIG. 6 AIRPHOTO PATTERN OF THE GRAVELLY WITH FINES OUTWASH PLAIN

The soil profile consists of a very dark colored, highly organic, A-horizon which varies in both depth, (from 10 to 30 inches) and texture (from organic silt loam to organic clay). The B-horizon varies from silty clay to clay. The parent materials also varies both in depth and texture. The depth to stratified gravel and/or sand usually ranges from 40 to 75 inches or more. However, in some areas the parent materials are mixtures of sand, silt and clay.

The sample obtained at site 31 shows that the C-horizon taken between 45 and 75 inches from the surface consists mostly of silt and clay and is classified as silty clay loam.

2. Terraces

Along the Wabash River, Wildcat Creek, Sugar Creek, and Indian Creek many terraces are recognized on the aerial photographs. The city of West Lafayette is located on a large, high terrace. The topographic break between the valley wall and the terrace surface are conspicious as is the terrace face. Generally, small infiltration basins and sometimes current scars are observed on the terrace surfaces throughout the county. In many places, high and low terraces are arranged in echelon with a terrace face of steep slope.

The soil profile on the terraces consists of a highly variable A-horizon due in part to variable depth of weathered loess cover. The depth of the A-horizon varies from zero on the steep terrace face to about 18 inches on the level terrace surface. The texture varies from a sandy loam to a silty clay loam. The B-horizon shows generally an increase of clay and plasticity with respect to the layer above. An increase in the amount of sand and gravel is found within the C-horizon. The parent materials are encountered at depths of 24 to 44 inches and consist of stratified sands and gravels. Samples obtained at sites 36 and 37 represent the conditions that are encountered.

Several gravel pits have been developed on the various terraces. The largest is located southwest of West Lafayette and a gravel face some 60 to 80 feet high has been worked.

3. Lacustrine Plains

There are two lacustrine plain deposits in Tippecanoe County. The larger one is located about three miles southwest of Montmorenci. The other occurs about one-half mile south of Odell. The former one is situated along a former glacial sluiceway and is illustrated in the upper part of Fig. 7. The latter one is only slightly lower than the surrounding area and is much more difficult to recognize on aerial photographs as shown in the lower part of Fig. 7.

The lacustrine plains are generally very flat with uniform dark tones on the aerial photographs and on the ground when compared to the surrounding areas (see Fig. 7). Ditches are constructed to drain the lacustrine plain depression.

The soil profile generally consists of a dark gray, highly organic, silty clay loam to clay topsoil. A gray, clay subsoil occurs and is underlain by a silty clay loam parent material. The sample obtained at site 10 shows considerable sand in the C-horizon and a layer of fine gravel was encountered at a depth of about 65 inches. The sample from site 14 is predominantly silt with no gravel and very little sand in the profile.

4. Alluvial Plains

All drainage channels in Tippecanoe County possess recent alluvial plains or flood plains. However, the extent of mapping of these plains was determined by the scale of the engineering soils map.

The largest alluvial plain is associated with the Wabash River. Wildcat Creek, Tippecanoe River and Wea Creek also exhibit wide alluvial plains. Most of the alluvial plains have flat to nearly level surfaces. Natural levees are developed along a portion of the large streams such as the Wabash River and Wildcat Creek.

The texture of the alluvial deposits varies greatly both horizontally and vertically from one place to the other depending mainly on the nature of the drainage basin. Coarse textured deposits are located along the Tippecanoe River, the Wabash River and Wildcat Creek. Very gravelly or stony deposits are found along the natural levees along these streams. The surface soil varies from a sandy loam, to silt loam or clay loam. The underlying layers are also extremely variable. Sandy gravel, sand, and clay loam are encountered in test sites 22 and 27. A less coarse textured deposit is found on the narrower flood plains in the county. Samples taken at site 38 on Wea Creek represent this condition. The surface soil is high in organic matter because of the prairie vegetation cover in that region. A high percentage of sand is present throughout the entire profile.

In the swales and depressions along the alluvial plains where water may be ponded, a highly organic silt loam, silty clay loam, silty clay or clay topsoil may be found. The subsoil varies from silt loam to silty clay or stratified silt, sand and clay may be present. Occasionally it may contain thin layers of sandy gravelly material, and in several areas shale bedrock may be found 4 to 5 feet from the surface.

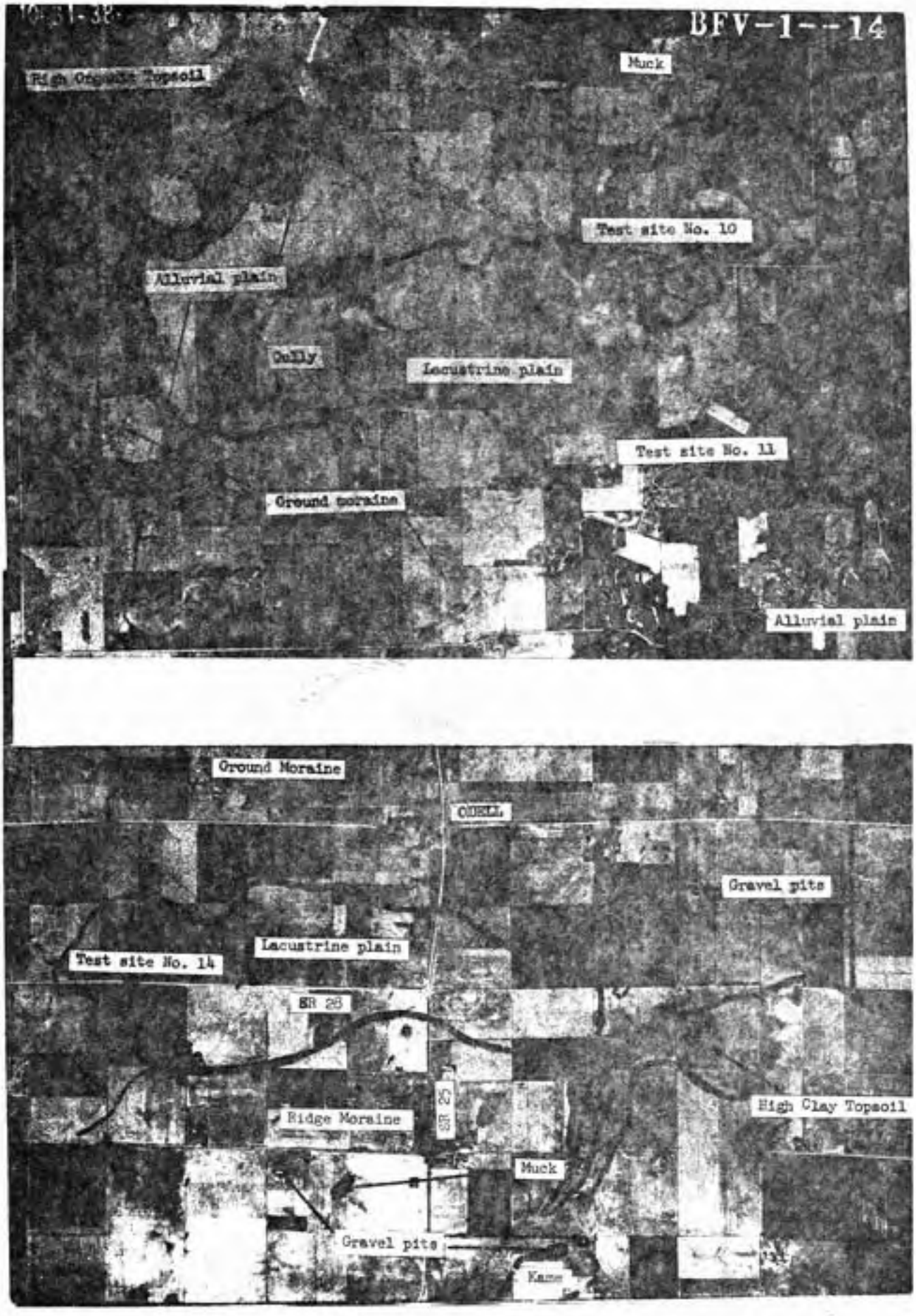


FIG. 7 AIRPHOTO PATTERN OF LACUSTRINE PLAINS IN TIPPECANOE COUNTY

EOLIAN DEPOSITED MATERIAL

There are extensive eolian deposits in Tippecanoe County. The eolian deposits are subdivided into two groups: loess mantle deposits and sand dune deposits.

About 80 percent of Tippecanoe County is covered by a thin mantle of loess. As mentioned previously the mantle varies in depth from 18 to 36 inches. Since the mantle is rather uniform and comparatively thin, only the top part of the soil profile is subject to its influence. The discussion of this loess mantle is not treated separately but included with the glacial land forms previously discussed.

Sand Dunes

The sand dunes deposits in Tippecanoe County are confined to the terraces and flood plains along the Wabash River and on the Wea outwash plains.

The sand dunes in this county are irregular in shape and exhibit softly rolling to rolling topography. The dunes vary from 4 to 15 feet in height. They are easily identified on the aerial photographs. Some of the dunes are active and show blowouts.

The typical soil profile consists of a very friable sand or sandy loam topsoil underlain by a loose sandy B-horizon with occasionally thin layers or bands of loam or sand clay loam in the lower part of the profile. The C-horizon is composed of loose fine sand.

The obtained sample at site 12 is typical for the sand dune deposits. It is classified as sand throughout the entire profile. Samples obtained at site 21 were taken on the border of the dune. The influence of the surrounding terrace deposit is obvious; therefore, the profile should not be considered as typical sand dune deposit.

RESIDUAL SOIL

Residual soils (or Colluvial Soils) developed from interbedded shale and sandstone are found to a limited extent in Tippecanoe County. Most of the residual soils are located near the foot of the valley wall along the Wabash River near Americus and along the northern valley wall near the Warren County border in the western part of the county. Along both banks of Flint Creek south of West Point and some of its tributaries bedrock is exposed on the surface. Since most of the exposures are in a very small area, many cannot be recognized or mapped at the scale of the soils map. Therefore, only an area just southeast of West Point is shown on the map.

The soil is developed on a steep slope from thick bedded, coarse-grained sandstones and thinly bedded shales. The soil profile shows that under a thin layer of organic or humus silt loam the A-horizon varies from a stony silt loam to a stony silty clay loam. The amount of fragments of shale and sandstone increases with depth and so also does the amount of clay content in the B-horizon. Bedrock of shale and sandstone is encountered at depths from 9 to 36 inches.

CUMULOSE MATERIALS

Accumulations of cumulose or organic materials occur frequently on the various land forms previously described. The most frequently occurring cumulose deposits occupy kettle basins in the ridge moraines and ground moraines. On relatively flat areas or slight depressions, highly organic topsoils may occur that would influence engineering decisions. Also, accumulations of clay topsoils in depressions may occur as well as local swamp conditions. These cumulose deposits are indicated on the map and discussed as follows:

1. Kettle Basins

Cumulose deposits of muck and peat occur in many of the kettle basins randomly scattered throughout the country. Most of the peats are derived from mosses, sedges and wood. In some kettle basins a soft layer of marl, ranging from zero to 12 inches in depth, is found under about 12 to 42 inches of muck. The marl is an earthly material composed principally of an amorphous form of calcium carbonate. Since it is also undesirable from the engineering standpoint, no separation is made from the peat and muck in the soil profile illustrated. The depth of these cumulose deposits varies greatly from one location to another, therefore field investigation of each individual deposit is required. Site 25 represents a condition encountered.

2. Highly Organic Topsoil Depressions

Depressed areas, where external and internal drainage is somewhat retarded particularly on the ground moraines give rise to the accumulation of organic topsoil. A large number of such deposits occur in Tippecanoe County. Many of them are concentrated in the region between Lafayette and Dayton. Some of them are located adjacent to the muck kettles. Where areas of highly organic topsoils occur an appropriate symbol is used on the map.

The soil profile consists of an organic silty clay or clay topsoil, a plastic silty clay or clay subsoil and a loam or clay loam parent material. The samples obtained at site 29 shows that both the surface soil and the subsoil are highly organic.

3. Clay Depressions

In Tippecanoe County there are many shallow depressions showing a dark photo tonality that are not organic materials but accumulations of clay. These soils are generally associated with the high organic topsoil deposits. They occur in the deeper parts of the elongated swales and depressions and in the kettle holes. The surface soil is a highly plastic clay containing very little organic matter. This clay soil is very difficult to differentiate from the highly organic topsoil area by airphoto interpretation techniques because both show a relatively dark gray. Therefore, many field checks were made to establish its identity. The subsoil as well as the parent material are essentially the same as those mentioned in the highly organic topsoil areas. A symbol indicating high clay content differentiate these areas.

4. Swamps

There are a few swamps in Tippecanoe County. A few of them are located in the vicinity of Octagon and Cairo. Others occur northeast of South Raub and southwest of Corwin. Due to the low topographic position and the poorly drained soil conditions inundation is almost continuous and grasses and reeds thrive. A layer of organic material is usually present below the water. Clay, highly organic topsoil and muck may be found in these swamps. A swamp symbol is superimposed on these areas on the map.

BIBLIOGRAPHY

1. Frost, R. E., et al., "Manual on the Airphoto Interpretation of Soils and Rocks for Engineering Purposes," Joint Highway Research Project, Purdue University, Lafayette, Indiana, March 1953.

2. Ulrich, H. P., et al., "Soil Survey of Tippecanoe County, Indiana" Series 1940, No. 22, United States Department of Agriculture, Government Printing Office, Washington, D. C., January 1959.

3. Belcher, D. J., Gregg, L. E. and Woods, K. B., "The Foundation, Distribution and Engineering Characteristics of Soils" Engineering Bulletin, No. 87, Engineering Experiment Station, Purdue University, Lafayette, Indiana, 1943.

4. "United States Census of Population 1960" Bureau of Census, United States Department of Commerce, Government Printing Office, Washington, D.C., 1961.

5. "United States Census of Agriculture 1959" Vol. I, Part 11, Bureau of the Census, United States Department of Commerce, Government Printing Office, Washington, D. C., 1961.

6. Fidlar, M. M., "Physiography of the Lower Wabash Valley" Indiana Department of Conservation, Division of Geology, Bulletin No. 2, Indianapolis, Indiana, June 1948.

7. "Climatological Data of Indiana" Weather Bureau, United States Department of Commerce, Government Printing Office, Washington, D. C.

8. Logan, W. N., "Handbook of Indiana Geology," Indiana Department of Conservation, State of Indiana, Indianapolis, Indiana, 1922.

9. Leverett, F. and Taylor, F. B., "The Pleistocene of Indiana and Michigan and the History of the Great Lakes" Monographs of the United States Geological Survey, Volume LIII, Government Printing Office, Washington, D. C., 1915.

10. Logan, W. N., "The Sub-Surface Strata of Indiana" Publication No. 108, Division of Geology, Indiana Department of Conservation, Indianapolis, Indiana, 1931.

11. "Ground-Water Resources of Tippecanoe County, Indiana," Bulletin No. 8, Indiana Department of Conservation, Division of Water Resources, Indianapolis, Indiana, (Appendix 1956) 1958.

Table II

SOIL TEST DATA FOR [illegible] COUNTY

Site No.	Horizon	Depth in Ft.	Gradation Distribution: Gravel Greater Than #4 %	Fine Gravel #4-#10 %	Coarse Sand #10-#40 %	Fine Sand #40-#200 %	Silt (#200-0.005) %	Clay Less Than 0.005 %	Liquid Limit %	Plastic Index %	Standard Laboratory Compaction (AASHO T99): O.M.C. %	Max. Dry Weight pcf	Soil Group	Soaked Moisture Content for CBR Test	Unified Classification	AASHO Classification
1	A_{12}	2/3-1 1/4	0	0	3	29	36	32	36	17	16.7	104.8 (D)	7	17.7	CL	A-6 (10)
	B_{21g}	1 3/4-2 1/4	0	1	2	29	37	31	34	17	15.4	110.6 (D)	6	15.2	CL	A-6 (10)
	B_{22g}	2 1/2-5	0	0	3	55	29	13	18	—	9.6	121.0 (D)	—	—	SM	A-4 (1)
	C	5 1/2-7 1/2	11	2	10	30	25	21	16	4	9.1	125.0 (D)	3	9.3	SM-SC	A-4 (2)
2	A_{12}	2/3-1 1/4	0	0	2	34	51	22	42	17	21.1	97.1 (A)	7	21.5	CL	A-7-6 (11)
	B_{22}	1 3/4-2 7/12	0	0	1	14	48	37	43	24	19.9	104.7 (A)	6	20.3	CL	A-7-6 (14)
	B_{23}	2 7/12-3 1/3	0	0	1	2	69	28	33	11	13.6	111.2 (D)	11	15.5	ML-CL	A-4(8)
	C	3 3/4-4 7/12	1	1	5	19	47	27	13	7	12.6	121.3 (D)	7	12.9	ML-CL	A-4 (3)
3	A_p	1/6-5/6	0	0	2	10	69	19	44	8	23.9	89.7 (A)	5	26.5	CL	A-4 (8)
	B_{21}	1 1/4-2 1/12	1	1	4	20	37	35	34	13	18.0	105.5 (C)	7	18.2	CL	A-6 (9)
	C	4 1/6-5 1/2	2	2	5	14	42	35	26	6	17.2	111.0 (A)	3	16.9	ML-CL	A-4 (8)
4	A_p	0-1/2	0	1	3	13	31	32	44	18	22.0	97.4 (A)	7	20.9	CL	A-7-6 (12)
	B_{21g}	1 1/4-2 7/12	0	1	3	10	39	31	32	13	14.5	114.0 (A)	3	14.3	CL	A-6 (9)
	B_{22g}	2 7/12-4 1/6	0	0	1	7	51	41	50	29	18.5	108.9 (C)	7	18.9	CL	A-7-6 (17)
	C	4 1/6-6	16	7	22	27	16	12	22	7	11.2	124.2 (D)	9	10.5	SM-SC	A-2-4 (0)
5	A_1	0-1	0	1	3	11	38	27	35	12	23.0	99.1 (A)	3	22.9	CL	A-6 (9)
	B_{22}	1 1/3-2 1/4	3	2	5	13	36	41	46	24	21.6	101.7 (A)	6	21.1	CL	A-7-6 (15)
	C	2 5/6-3 11/12	8	7	11	18	31	24	29	11	14.3	118.1 (C)	4	14.4	CL	A-6 (5)
6	A_{12}	7/12-1 1/6	0	1	1	4	37	37	44	18	22.1	97.4 (A)	8	21.9	CL	A-7-6 (12)
	B_{22}	1 2/3-2 1/2	0	0	2	3	48	47	57	32	28.2	100.3 (A)	9	22.4	CH	A-7-6 (19)
	B_{23}	2 1/2-4 1/6	1	1	5	13	53	27	31	13	15.1	119.1 (D)	9	15.2	CL	A-6 (9)
	C	4 1/3-6	6	4	12	23	31	24	22	7	10.5	121.5 (D)	10	10.0	ML-CL	A-4 (4)
7	A_p	0-7/12	0	0	2	5	71	19	24	3	17.9	99.6 (A)	9	18.8	ML	A-4 (8)
	B_{21}	1 1/4-2 1/2	2	3	8	23	30	34	34	16	15.0	109.4 (A)	8	13.2	CL	A-6 (8)

Table II (continued)

Site No.	Horizon	Depth in Ft.	Gravel Greater Than #4 %	Fine Gravel #4-#10 %	Coarse Sand #10-#40 %	Fine Sand #40-#200 %	Silt .005-0.005 mm %	Clay Less than 0.005 mm %	Liquid Limit %	Plastic Index %	Standard Laboratory Compaction Typical: O.M.C. %	Max. Dry Weight pcf	CBR (Surcharge 35 lbs.)	Molded Moisture Content for CBR & Test	Unified Classification	AASHO Classification
7	B_{23}	2 1/2-4 1/4	9	6	13	26	19	27	31	15	14.0	126.4 (D)	3	13.6	SC	A-6 (4)
	C	4 1/4-5 5/12	13	6	13	24	24	20	22	8	10.2	125.3 (D)	4	9.9	SC	A-6 (2)
	A_1	0-7/12	0	0	4	6	68	22	44	12	24.8	90.6 (A)	4	23.1	ML	A-7-5 (10)
8	B_{21}	1 1/2-2	0	0	0	2	61	37	44	21	19.4	104.8 (A)	7	19.6	CL	A-7-6 (13)
	B_{22}	2-2 1/2	1	4	2	9	54	30	37	20	17.3	107.7 (A)	9	17.1	CL	A-6 (12)
	C	5 5/12-6 2/3	4	5	12	28	31	20	22	6	12.2	122.4 (C)	—	—	ML-CL	A-4 (3)
9	A_p	0-3/4	0	1	7	37	38	17	35	6	20.4	97.5 (A)	6	20.3	CL	A-4 (4)
	B_1	1 1/2-2 2/3	0	1	3	62	32	22	28	10	10.7	121.2 (A)	—	—	CL	A-4 (4)
	B_2	2 2/3-4 1/4	1	3	7	24	33	32	33	14	16.3	112.2 (A)	3	16.0	CL	A-6 (8)
	C	4 7/12-5 5/6	4	4	10	22	39	21	30	6	11.1	122.6 (D)	2	11.4	ML-CL	A-4 (5)
10	A_p	0-7/3	0	0	1	10	65	24	34	8	17.3	100.3 (A)	8	18.5	CL	A-4 (8)
	B_{21g}	1 1/4-2	0	1	1	6	61	31	40	21	15.8	110.2 (D)	5	16.1	CL	A-6 (12)
	$B22_g$	2-3 1/6	0	0	1	3	49	47	54	41	21.0	97.8 (A)	7	21.3	CH	A-7-6 (20)
	C	3 1/3-5	3	3	5	17	53	19	27	12	12.6	126.7 (D)	5	13.1	CL	A-6 (8)
11	A_p	0-7/12	0	0	1	6	70	23	31	7	18.0	99.8 (A)	12	18.6	ML-CL	A-4 (8)
	B_{23}	2 1/3-3 3/4	9	3	3	14	40	23	30	12	14.8	111.3 (A)	5	14.4	CL	A-6 (8)
	C	7 1/12-8 1/2	3	4	10	24	36	23	22	7	10.8	121.8 (D)	8	10.4	ML-CL	A-4 (5)
12	A	0-1	0	0	3	86	3	8	NP	NP	12.1	111.7 (A)	28	12.6	SP-SM	A-2-4 (0)
	B_2	1 1/2-2 1/2	0	0	4	87	4	5	NP	NP	12.7	111.5 (A)	15	12.9	SP-SM	A-3 (0)
	C	2 1/2-5 1/2	0	0	4	89	2	5	NP	NP	13.4	104.4 (A)	15	15.0	SP-SM	A-3 (0)
13	A_p	0-7/3	0	1	4	18	44	33	34	11	19.4	102.6 (D)	6	19.7	CL	A-6 (8)
	B_{22}	1 11/12-3 1/4	1	1	2	43	31	22	24	8	14.5	114.8 (A)	—	—	CL	A-4 (4)
	B_{23}	3 1/4-5	1	2	12	70	5	10	NP	NP	12.7	117.0 (A)	16	13.1	SM	A-2-4 (0)
	C	5 5/12-7 3/4	4	7	31	31	1	6	NP	NP	12.8	114.4 (A)	—	—	SP-SM	A-3 (0)

Table II (continued)

Hole No.	Sample No.	Depth in Ft.	Gravel Greater Than 3" %	Fine Gravel (3"-#10) %	Coarse Sand (#10-#40) %	Fine Sand (#40-#200) %	Silt (#200-0.005 mm) %	Clay (Less than 0.005 mm) %	Liquid Limit %	Plastic Index %	Standard Laboratory Compaction (AASHO T 99) O.M.C. %	Max. Dry Weight pcf	CBR (Swelling) % (Surcharge 10 lbs.)	Molded Moisture Content for CBR Test	Unified Classification	AASHO Classification
16	A_1	0-1/2	0	0	0	2	18	12	28	18	22.4	97.5	(a) 5	21.8	SC	A-6(8) (12)
	B_{21}	1 1/2-2 5/12	0	0	0	1	19	44	32	20	19.0	105.9	(a) 7	19.4	CH	A-7-6 (19)
	C	4-5	0	0	0	2	18	20	25	4	14.0	114.3	(b) 11	14.0	SC-SM	A-4 (8)
17	A_1	0-1/12	1	0	7	23	42	27	29	11	15.0	109.4	(b) 8	15.6	SC	A-6 (7)
	B_{21-22}	1 1/2-3	4	1	6	24	15	30	32	14	16.8	114.7	(a) 6	15.0	SC	A-6 (8)
	C	3-4 1/2	26	12	17	22	5	10	22	12	10.4	128.0	(a) 5	10.5	SM	A-2-4 (0)
18	A_1	0-1/2	0	0	2	4	14	30	29	6	17.3	106.0	(a) 8	16.6	SC-SM	A-4 (8)
	B_{21}	1 1/2-2 11/12	0	0	2	1	49	48	46	20	20.4	101.8	(a) 10	21.0	SC-SM	A-7-6 (12)
	C	3 1/2-4 1/2	18	6	9	24	23	20	19	3	10.8	128.0	(a) 4	11.2	SM-SC	A-4 (1)
19	A_1	0-1/2	1	1	3	8	42	25	24	7	14.2	103.6	(a) 9	16.1	SC	A-4 (6)
	B_{21}	2 1/12-4 1/2	0	0	0	2	60	38	44	21	20.5	100.8	(a) 6	21.6	CL	A-7-6 (13)
	B_{23}	5-7 1/2	9	4	12	34	16	25	30	15	12.2	118.2	(b) 8	12.2	SC	A-6 (3)
	C	7 11/12-9	21	9	12	29	27	16	27	7	6.7	129.1	(a) 5	6.9	SM-SC	A-4 (2)
20	A_1	0-1/12	1	0	3	6	42	28	43	16	28.4	98.9	(b) 9	19.4	CL	A-7-6 (11)
	B_{21}	2 1/12-3 1/12	0	0	1	3	34	62	44	23	18.0	110.5	(b) 10	17.8	CL	A-7-6 (14)
	B_{22}	3 1/2-5 7/12	4	4	5	24	27	36	27	12	12.7	118.7	(b) 3	11.0	CL	A-6 (6)
	C	6-7 5 /6	3	3	6	23	29	33	26	13	13.5	117.6	(b) 2	12.7	CL	A-6 (5)
21	A_1	0-1/2	1	2	3	11	33	51	44	21	21.9	99.1	(b) 7	21.4	CL	A-7-6 (14)
	B_2	1 1/2-2 5/12	1	0	1	7	30	61	57	35	28.1	102.0	(b) 8	28.2	CH	A-7-6 (29)
	C	2 1/2-3 3/4	4	4	5	23	31	33	34	20	20.9	112.4	(a) 10	20.3	CL	A-6 (6)
22	A_1	0-1/12	1	2	3	9	40	45	31	9	17.3	110.3	(b) 7	18.0	SC	A-6 (7)
	B_{21}	1 1/12-2 1/2	—	—	—	—	—	—	33	21	20.2	114.7	(b) 9	19.8	—	———
	B_{22}	2 1/2-4 3/4	9	4	3	29	24	31	34	17	13.5	121.2	(b) 7	13.1	CL	A-6 (8)
	C	4 3/4-6 1/2	5	4	7	33	27	14	15	1	10.1	126.1	(b) 3	10.3	CL	A-4 (3)

Table II (continued)

Site No.	Horizon	Depth in Ft.	Grain-Size Distribution: Gravel Greater Than [illegible] %	Fine Gravel [illegible] %	Coarse Sand [illegible] %	Fine Sand [illegible] %	Silt [illegible] mm %	Clay Less than 0.005 mm %	Liquid Limit %	Plastic Index %	Standard Laboratory Compaction: O.M.C. %	Max. Dry Weight pcf	CBR (Surcharge 35 lbs)	Molded Moisture Content for CBR Test	Unified Classification	AASHO Classification
21	A	0-1/2	1	0	4	48	36	11	23	—	12.6	115.0 (A)	12	12.5	SM	A-4 (2)
	B_1	1-2 1/2	0	1	1	38	39	21	NP	NP	11.6	120.4 (A)	4	11.8	ML	A-4 (5)
	B_2	2 1/2-3 5/12	19	3	5	40	15	18	27	11	13.9	115.7 (D)	5	13.7	SC	A-2-6 (0)
22	A_p	0-2/3	0	1	10	22	38	29	45	21	19.0	108.2 (D)	9	19.4	CL	A-7-6(11)
	C_1	1 1/4-3	43	7	11	18	12	9	39	19	14.7	111.9 (D)	—	—	GC	A-2-6 (1)
	C_2	3-4 7/12	19	6	20	49	1	5	NP	NP	13.4	115.6 (D)	21	13.5	SP-SM	A-3 (0)
	C_3	4 7/12-5 1/2	40	37	8	12	1	2	NP	NP	9.9	130.2 (D)	38	10.0	SP	A-1-a (0)
23	A_p	0-7/12	5	2	6	31	37	19	28	10	13.8	110.5 (D)	7	13.6	CL	A-4 (4)
	B	5/6-1 3/4	7	1	7	19	27	39	40	23	18.6	110.7 (A)	4	19.1	CL	A-6 (11)
	C	1 3/4-3	7	4	10	28	27	24	25	10	11.3	122.8 (D)	3	11.3	CL	A-4 (4)
24	A_p	0-7/12	1	1	4	6	67	21	31	10	17.6	103.6 (D)	7	17.8	ML-CL	A-4 (8)
	B_{22}	1 5/6-2 5/6	1	0	1	4	58	36	49	27	21.8	107.2 (D)	5	21.6	CL	A-7-6 (17)
	C	3 1/2-4 1/2	1	3	8	30	36	22	22	10	11.3	122.7 (D)	6	11.9	CL	A-4 (5)
25	A_1	0-1	—	—	—	—	—	—	107	36	60.0	34.0 (A)	—	—	PT	Muck
	B_{21E}	1-2 1/3	—	—	—	—	—	—	198	87	80.7	41.2 (A)	—	—	PT	Muck
	B_{22E}	3 1/3-4 7/12	—	—	—	—	—	—	79	30	35.2	75.0 (D)	—	—	PT	Muck
	C	4 7/12-8	0	0	0	4	74	22	60	26	33.5	81.6 (D)	—	—	OH	A-7-5 (18)
26	A_p	0-2/3	1	1	3	14	51	30	48	20	21.5	98.7 (D)	4	21.6	CL	A-7-6 (14)
	B_2	1 2/3-2 11/12	0	0	1	8	48	43	58	29	19.1	101.2 (D)	6	18.9	CH	A-7-6 (18)
	C	4-5 5/6	6	4	7	27	36	20	24	12	10.3	124.4 (D)	5	10.2	CL	A-6 (5)
27	A_p	0-2/3	0	0	4	49	33	14	27	7	13.0	114.5 (D)	12	13.1	SM-SC	A-4 (2)
	C_1	2/3-2	5	2	7	33	32	21	30	12	15.0	111.7 (D)	3	15.4	CL	A-6 (5)
	C_2	2-3 1/12	34	12	15	22	9	8	22	7	10.0	126.8 (D)	9	8.9	SC-SC	A-2-4 (0)

Table II (continued)

Site No.	Horizon	Depth in Ft.	Gravel Greater Than 2 mm %	Fine Gravel 2-1 mm %	Coarse Sand 1-0.5 mm %	Fine Sand 0.5-0.1 mm %	Silt 0.1-0.005 mm %	Clay Less than 0.005 mm %	Liquid Limit %	Plastic Index %	Standard Laboratory Compaction (ASTM D698) Max. Dry Weight pcf	Opt. Moisture %	Soluble Salts Content for Cl Test	Unified Classification	AASHO Classification
20	A_p	0-1/3	0	0	2	12	64	22	29	6	107.0	16.7	15-01	CL	A-6 (8)
	B_{21}	1 1/3-4 1/3	0	0	1	4	65	30	34	20	99.7	20.1	01	CL	A-7-6 (19)
	B_{22}	4 1/3-8	0	0	2	10	59	29	36	16	102.5	17.8	01	CL	A-6 (12)
29	A_p	0-1/3	0	0	1	2	67	30	43	27	98.8	19.7	01	CL	A-7-6 (20)
	B_{21w}	1-1 1/3	0	0	1	3	67	29	38	20	99.5	20.0	01	CL	A-7-6 (18)
	C	2-3	7	3	5	22	44	19	25	10	110.3	13.7	01	CL	A-6 (5)
27	A_p	0-1/3	0	1	7	24	30	38	37	14	103.0	19.3	95-01	CL	A-6 (10)
	B_{22}	1 1/3-4 1/3	0	4	6	21	27	30	43	20	104.0	18.3	01	CL	A-7-6 (16)
	C	4-5 1/3	28	24	21	18	6	13	25	10	125.6	13.0	90	GC	A-2-6 (0)
28	A_p	0-1/3	1	2	4	4	49	40	42	27	91.4	22.2	01	CL	A-7-6 (19)
	B_{21g}	1 1/3-4 1/3	1	3	3	9	44	39	45	29	109.4	16.1	01	CL	A-7-6 (18)
	B_{22g}	4 1/3-5 1/3	0	0	0	7	66	27	36	16	109.8	14.7	01	CL	A-6 (11)
	C	5 1/3-6 1/3	0	0	1	6	63	30	30	19	106.7	16.0	01	CL	A-6 (11)
31	A_p	0-1/3	0	0	1	7	55	37	38	20	99.5	20.0	95-01	CL	A-6 (9)
	B_{21}	1-3	1	1	4	21	35	37	47	26	97.0	19.7	01	CL	A-7-6 (16)
	C	4 1/3-6	7	4	13	30	25	21	25	9	120.7	9.7	01	GC	A-2-6 (2)
30	A_p	0-1/3	0	0	4	13	53	30	35	9	105.4	17.4	95-01	CL	A-6 (9)
	B_{21}	1 1/3-3 1/3	1	1	7	21	39	31	37	17	111.9	13.3	01	CL	A-6 (10)
	B_{22}	4 1/3-6 1/3	11	8	24	32	4	21	30	13	117.7	12.0	01	GC	A-2-6 (2)
	C	6 1/3-7 1/3	25	14	41	14	3	3	23	7	125.7	10.9	90-01	GC	A-2-6 (1)
34	A_p	0-1/3	0	0	1	7	62	30	33	13	110.4	15.9	01	CL	A-6 (9)
	B_{22}	1 1/3-4 1/3	0	1	7	30	28	34	39	20	111.5	14.2	01	CL	A-6 (9)
	C	4 1/3-6 1/3	6	4	14	22	21	33	34	9	118.3	11.9	01	GC	A-2-6 (1)

Table II (continued)

Site No.	Sheet-No.	Depth in Ft.	Grain-size Distribution: Gravel Greater Than #4 %	Fine Gravel #4-#10 %	Course Sand #10-#40 %	Fine Sand #40-#200 %	Silt (#200-0.005) mm %	Clay Less Than 0.005 mm %	Liquid Limit %	Plastic Index %	Standard Laboratory Compaction (ASTM D 698)* O.M.C. %	Max. Dry Weight pcf	CBR (Soaked in 24 hrs.)	Soaked Moisture Content for CBR Test	Unified Classification	AASHO Classification
35	A_0	0-1/2	0	0	14	31	30	25	26	8	13.0	112.3 (D)	11	13.2	CL	A-4 (4)
	B_{22}	2-3	7	4	11	40	16	22	27	11	11.8	119.3 (D)	14	11.9	SC	A-6 (1)
	B_{23}	3-4 3/4	4	5	44	29	3	15	NP	NP	10.4	117.7 (D)	24	10.5	SM	A-1-b (0)
	C	4 3/4-6 1/4	9	8	39	33	4	7	NP	NP	11.2	117.5 (D)	24	11.2	SP-SM	A-1-b (0)
36	A_1	0-1/2	2	0	10	42	31	15	22	—	12.4	115.4 (D)	18	12.6	SM	A-4 (2)
	B_{22}	1 1/2-3	28	6	15	16	12	23	42	20	13.5	112.3 (D)	9	13.1	SC	A-2-7 (2)
	C	3 1/2-6 1/2	54	10	26	6	1	3	NP	NP	11.5	117.9 (D)	38	10.3	SW	A-1-a (0)
37	A_1	0-7/12	1	3	21	10	36	29	41	17	15.8	109.0 (D)	12	15.8	CL	A-7-6 (9)
	B_{21}	1 2/3-3 1/6	2	1	31	6	16	24	33	16	15.9	110.7 (D)	8	15.3	SC-CL	A-7-6 (5)
	C	3 1/2-4 1/2	5	1	30	6	3	5	NP	NP	14.6	114.6 (D)	29	13.5	SP-SM	A-1-b (0)
38	A_0	0-2/3	1	1	8	27	40	23	40	16	17.2	101.3 (D)	4	15.9	CL	A-6 (8)
	C_1	2/3-2 3/12	3	4	31	43	10	5	NP	NP	9.9	121.9 (D)	33	10.0	SM	A-2-4 (0)
	C_2	1 5/12-3 1/3	2	6	42	43	0	5	NP	NP	15.6	109.7 (D)	32	15.2	SP-SM	A-1-b (0)
	C_3	4 1/6-6 1/4	1	0	16	69	3	9	NP	NP	11.0	113.0 (D)	36	11.1	SM	A-2-4 (0)

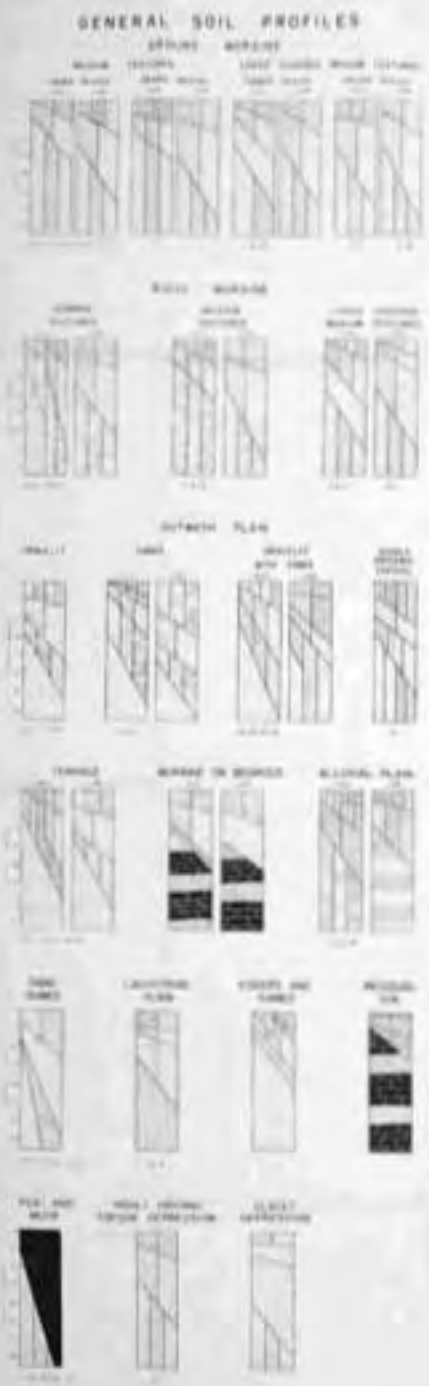
*The Method (A, B, C, or D) used for the Standard ASTM Compaction Test Type-57 is indicated in the parentheses.

JHRP 63/19 Edit Record 6 overseas

ENGINEERING SOILS MAP

TIPPECANOE COUNTY

INDIANA



ENGINEERING SOILS M

TIPPECANOE COU

INDIANA